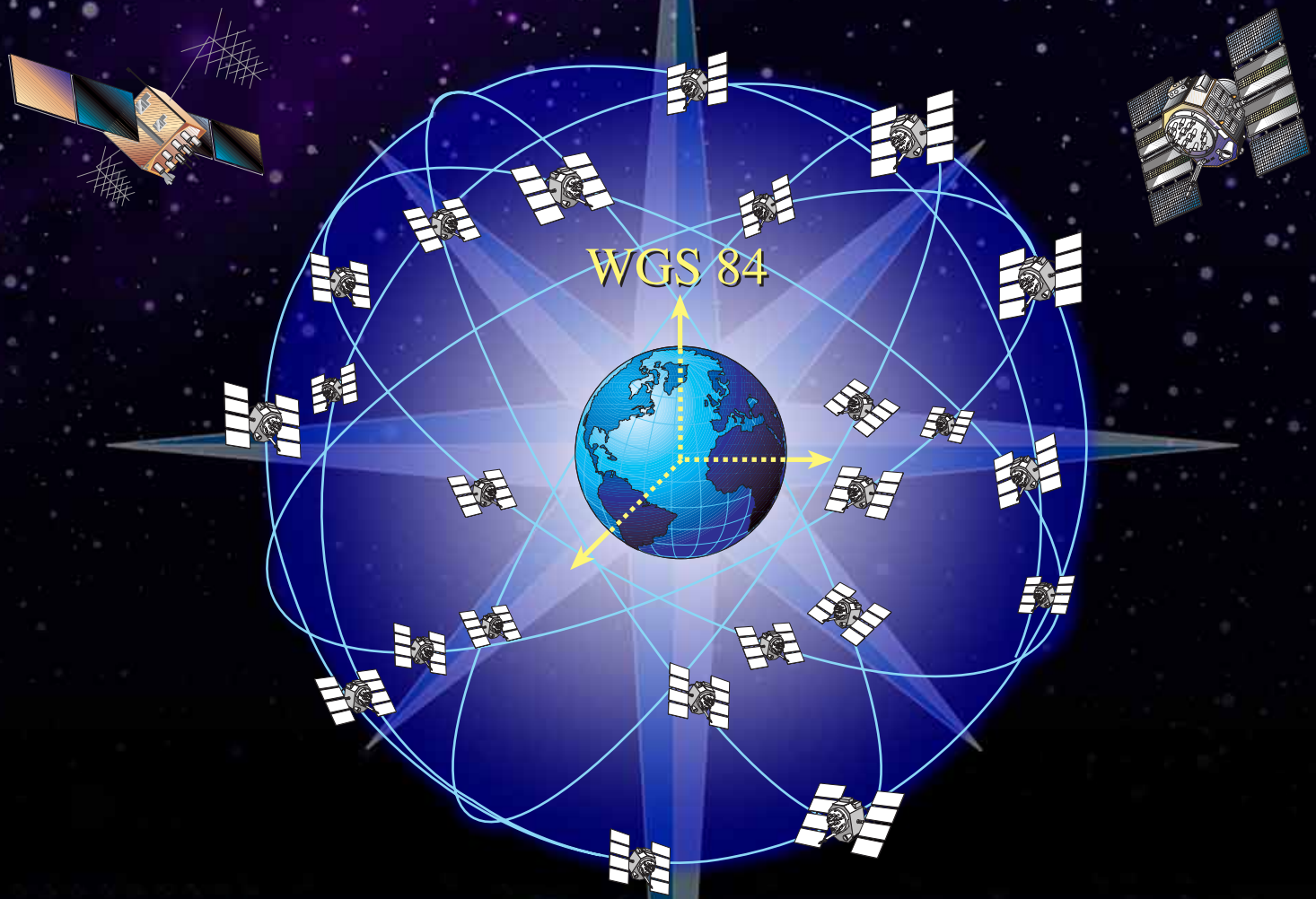
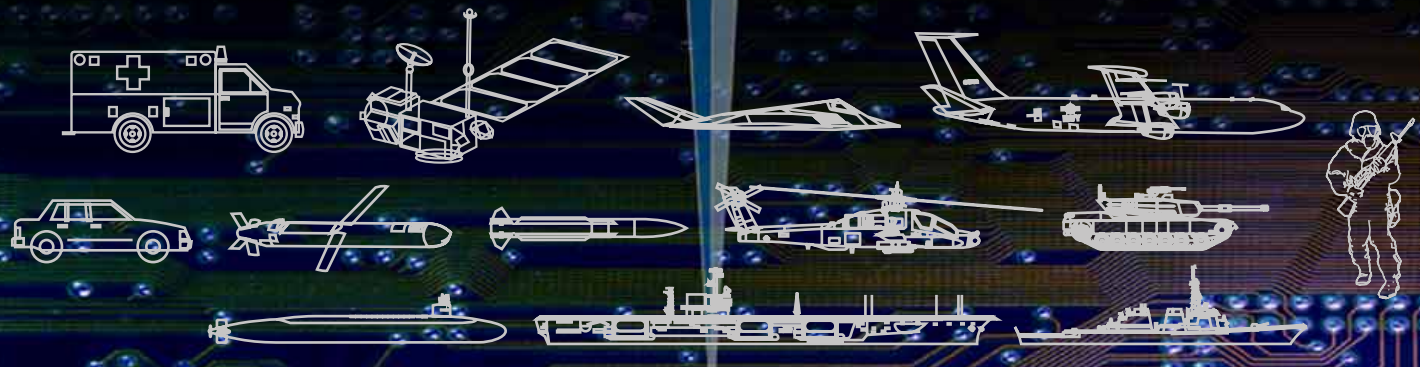
NAVAL SEA SYSTEMS COMMAND

GPS

GLOBAL POSITIONING SYSTEM



NAVAL SURFACE WARFARE CENTER, DAHLGREN DIVISION



DAHLGREN

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WARFARE SYSTEMS — NAVAL SURFACE WARFARE CENTER - DAHLGREN, VA

DAM NECK

Overview

By the end of the 1960s, the Department of Defense (DoD) realized the need to develop a three-dimensional, all-weather, global navigation system to support military operations and systems development. The Naval Surface Warfare Center, Dahlgren Division (NSWCDD), with its extensive experience in Transit navigation satellite missions and orbit determination, was chosen to participate in the early development work for what would become the NAVSTAR Global Positioning System (GPS). Since then, GPS-related development at NSWCDD has expanded to include precise orbit and clock estimation, reference frame definition, precise positioning, and other military applications. Originally intended just for navigation, GPS is now used for surveying, time synchronization, vehicle attitude determination, and numerous other purposes. It is used not only by DoD but by nearly every government agency and millions of private citizens worldwide. NSWCDD is proud to have played, and will continue to play, an important role in the development of GPS.

NSWCDD Contributions

During the past 38 years, NSWCDD has made significant contributions to GPS system performance, including key developments in the following areas:

- GPS constellation design
- Precise satellite orbit and clock estimation
- Tracking station positioning
- World Geodetic System (WGS) development
- GPS receiver development
- Precise positioning and attitude
- Submarine-Launched Ballistic Missile test and evaluation
- Space vehicle positioning
- 6-degree-of-freedom modeling and simulation

Orbit and Clock Estimation

NSWCDD developed and maintains the software system called OMNIS, which is used by the National Geospatial-Intelligence Agency (NGA) to produce precise satellite orbit and clock estimates. This software estimates orbits to an accuracy of 5 centimeters and time to an accuracy of 0.3 nanoseconds. These estimates are used for DoD precision GPS applications. A new software system called EPOCHA (Estimation and Prediction of Orbits and Clocks to High Accuracy) is currently under development. It will be both a life cycle replacement for OMNIS and provide a real-time estimation and prediction capability to support GPS users requiring decimeter-level positioning accuracy.

WGS 84 Reference Frame

The WGS 84 global reference frame is fundamental to all applications of GPS. NGA, with technical assistance from NSWCDD, defined the WGS 84 frame using satellite observations from all the permanent DoD GPS tracking stations. The coordinates of these stations have been determined to an accuracy of 1 centimeter. All GPS-derived navigation and positioning solutions are defined in this reference frame.

GPS Applications

Early work on precise positioning and attitude determination required extensive post-processing of tracking data. Recently, through advances in computer technology and data processing techniques, greater accuracies have been achieved in real time. GPS applications at NSWCDD include the following:

- Missile testing and miss-distance determination
- Theater Ballistic Missile Defense
- Precise navigation (GPS/Inertial Measurement Unit)
- Automated pilotless aircraft landing
- Extended-Range Guided Munition
- Near real-time targeting
- Antijam modeling and simulation

Future Efforts

NSWCDD is pursuing state-of-the-art technologies and analysis techniques that will ensure its continued presence at the forefront of precision GPS applications. These include the following:

- Very precise positioning and attitude
- Very high dynamic military applications
- Centimeter orbit accuracies
- Real-time 3-D positioning visualization

NAVSEA WARFARE CENTERS DAHLGREN

NSWCDD/MP-07/110: 2/08

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We are looking for scientists and engineers in different fields. For employment opportunities, please send your résumé to
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